UNITED NATIONS CONVENTION
ON THE LAW OF THE SEA

SPLOS

MEETING OF
STATES PARTIES

Distr.
GENERAL

SPLOS/CLCS/INF/1
10 June 1996

ORIGINAL: ENGLISH

Fifth meeting
New York, 24 July-2 August 1996

COMMISSION ON THE LIMITS OF THE CONTINENTAL SHELF: ITS FUNCTIONS AND SCIENTIFIC AND TECHNICAL NEEDS IN ASSESSING THE SUBMISSION OF A COASTAL STATE

Study prepared by the Secretariat

CONTENTS

		Paragraphs	Page
I.	INTRODUCTION	1 - 11	3
II.	REQUIREMENTS FOR, AND ANALYSIS OF, DATA SUBMITTED TO THE COMMISSION	12 - 64	5
	A. Overall considerations	12 - 15	5
	B. Requirements for, and analysis of, bathymetric and seismic data	16 - 37	6
	C. Requirements for, and analysis of, geodetic data	38 - 41	10
	D. Considerations to be given with respect to satisfying the 200-nautical-mile rule	42 - 43	11
	E. Considerations to be given with respect to satisfying the rules relating to the foot of the continental slope	44 - 60	11
	1. Sixty (60) nautical miles from the foot of the continental slope	44 - 51	11

96-14596 (E) 010796 020796

CONTENTS (continued)

		Paragraphs	Page
	2. A line delineated by reference to the outermost fixed points where the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope	52 - 60	15
F.	Considerations to be given with respect to satisfying the rule on limiting lines	61 - 64	16
	1. Three hundred fifty (350) nautical miles from the baselines	61 - 62	16
	2. One hundred (100) nautical miles seaward of the 2,500-metre isobath	63 - 64	16
III.	SUGGESTED FORMAT AND DISPOSITION OF MATERIAL USED AS PART OF A SUBMISSION	65 - 85	17
IV.	A CONCEPTUAL MODUS OPERANDI FOR THE COMMISSION	86	20
V.	TECHNICAL RESOURCES NEEDED BY THE COMMISSION	87	22

Annexes

I.	Information that the Commission may wish to consider requesting as part of a submission by a coastal State	28
II.	List of participants in the Meeting of the Group of Experts on preparations for the establishment of the Commission on the Limits of the Continental Shelf	36

I. INTRODUCTION

1. The Division for Ocean Affairs and the Law of the Sea of the United Nations Office of Legal Affairs continues its efforts to promote the uniform development of State practice in a manner consistent with the provisions of the United Nations Convention on the Law of the Sea (the Convention), which entered into force on 16 November 1994. Acting as the secretariat of the Convention, the Division has been producing a series of special studies which are intended to provide assistance to States in their application of some highly technical provisions of the Convention.

2. The present study, undertaken with the assistance of a representative group of experts convened at United Nations Headquarters from 11 to 14 September 1995, is devoted to certain technical and scientific aspects of the work of the Commission on the Limits of the Continental Shelf (the Commission). The Convention provides that the Commission shall be established within 18 months after the date of entry into force of the Convention, i.e., before 16 May 1996. 1/ However, at a meeting of States Parties to the Convention (27 November- 1 December 1995), it was decided to defer the establishment of the Commission until March 1997. 2/

3. The Commission is to play an important role in the establishment of the outer limits of the continental shelf of coastal States beyond 200 nautical miles. The functions of the Commission shall be:

> "(a) to consider the data and other material submitted by coastal States concerning the outer limits of the continental shelf in areas where those limits extend beyond 200 nautical miles, and to make recommendations in accordance with article 76 and the Statement of Understanding adopted on 29 August 1980 by the Third United Nations Conference on the Law of the Sea;
>
> "(b) to provide scientific and technical advice, if requested by the coastal State concerned during the preparation of the data referred to in subparagraph (a)". 3/

4. The members of the Commission are to be elected at a meeting of States Parties convened by the Secretary-General at United Nations Headquarters. 4/ The Commission shall consist of 21 members, serving in their personal capacities, who shall be experts in the field of geology, geophysics or hydrography and be elected by States Parties from among their nationals, having due regard to the need to ensure equitable geographical representation. 5/ The secretariat of the Commission shall be provided by the Secretary-General of the United Nations. 6/

5. It should be noted that article 76 of the Convention contains complex technical formulae for the definition of the continental shelf. The term "continental shelf" is used in article 76 not in a geomorphological sense but as a legal concept. Coastal States have the right to claim the seabed and subsoil up to 200 nautical miles from the baselines from which the breadth of their territorial sea is measured, even where their geomorphological continental

margin falls short of that extent. In cases where the continental margin extends beyond 200 nautical miles, the coastal State, if it meets specific technical criteria, can establish the outer limits of the legal "continental shelf" up to 350 nautical miles from the baselines, or up to 100 nautical miles seaward of the 2,500-metre isobath, whichever is further seaward. It does not include the deep ocean floor with its oceanic ridges or the subsoil thereof.

6. The limits to be defined in the submission from a coastal State with a continental shelf that extends beyond 200 nautical miles are to be based on distances measured with respect to "the foot of the continental slope" near the edge of the submerged prolongation of its land mass. Data in support of such a submission could therefore include bathymetric data, seismic and other geophysical data and geological information. The submission may define the limits of the continental shelf 60 nautical miles seaward of the foot of the slope, in which case only additional geodetic information might be necessary. However, the submission may define the limits of the continental shelf even further seaward, based upon the thickness of the sedimentary wedge extending beyond the foot of the continental slope. Such a submission will generally be supported by additional seismic reflection and velocity data.

7. In the course of examination of the coastal State's submission, the Commission will have to analyse a large volume of complex geodetic, bathymetric, seismic and possibly other geophysical data in order to verify that the geological and geomorphological conditions support the coastal State's submission. The quality and quantity of these supporting data will generally be related to the purpose for which they are presented in the context discussed above.

8. Upon completion of such examination, the Commission shall submit its recommendation, in writing, to the coastal State which made the submission and to the Secretary-General of the United Nations. 7/ The limits of the continental shelf established by a coastal State on the basis of such recommendation shall be final and binding. 8/ However, in the case of disagreement by the coastal State with the recommendation of the Commission, the coastal State shall, within a reasonable time, make a revised or new submission to the Commission. 9/

9. In an effort to prepare the Commission for its work, and without prejudice to the decisions it may take, the Division for Ocean Affairs and the Law of the Sea has attempted to identify some of the issues that will need to be addressed by the Commission when it begins its examination of the submissions of coastal States. The decisions on these issues could be of importance to the coastal States since the Commission is "to provide scientific and technical advice, if requested by the coastal State concerned during the preparation of the data" for such a submission (see para. 3 above).

10. Since the issue of the definition of the continental shelf as contained in article 76 of the Convention had been addressed by the Division in 1993 in convening a group of experts and publishing a study, 10/ the 1995 meeting of the Group of Experts focused its attention on the functions and scientific and technical needs of the Commission and on the possible format of the coastal State's submission regarding its continental shelf. However, since the present

document precedes the establishment of the Commission, its content must be taken as indicating only the standards the Commission may wish to apply in its consideration of the submissions by coastal States.

11. The names of the members of the 1995 Group of Experts, serving either in their personal capacities or as representatives of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) or of the International Hydrographic Organization (IHO), are listed in annex II to the present study. The Division for Ocean Affairs and the Law of the Sea gratefully acknowledges the valuable contribution of all participants to the preparation of this study.

II. REQUIREMENTS FOR AND ANALYSIS OF DATA SUBMITTED TO THE COMMISSION

A. Overall considerations

12. As noted in the introduction, the continental shelf as legally defined in article 76 of the Convention is to be distinguished from what geoscientists recognize as a geomorphological continental shelf. The intent of the definition appears to be to include the majority of that part of the margin that is underlain by rocks that are a natural submarine extension of the land mass, and the sedimentary wedge derived from both the land mass and its natural submarine extension. The sediment thickness rule provides States the opportunity to optimize the extent of the outer continental shelf boundary and is intended to define the effective seaward limit of the sedimentary wedge derived from the land mass.

13. The coastal State may properly combine the output of the various calculations provided for in article 76 to maximize the area of its continental shelf. It is then for the Commission to decide whether the coastal State's submission, including the data on which it is based, complies with article 76 and Annex II to the Convention.

14. The coastal State may use data collected with a range of techniques from a wide variety of sources in establishing its proposed limits. In considering the type of data it deems satisfactory, the Commission may wish to consider the implications of high-quality data collected with modern technology not being available to some countries.

15. The Commission may also wish to consider recommending to all relevant States at an early stage of its work the adoption of a common horizontal datum in the World Geodetic System (WGS) series, such as WGS 84 or subsequent WGS Datum. Where this datum cannot be used as the geodetic reference system within which the primary data has been collected because of national legislation, the Commission may wish to ask for the appropriate conversions between datums to have been made.

B. Requirements for, and analysis of, bathymetric and seismic data

16. Article 76 provides for a choice among various criteria under which coastal States may make claims to the natural prolongation of their land territory. These options are based on the morphology of the sea floor, normally derived from depths measured from the ocean surface to the sea floor and the thickness of sediment beneath the sea floor. The methods used for measurement, analysis and presentation of these data all contribute to their accuracy. Limits of the continental shelf based on article 76 must therefore be proposed and assessed on the basis of a comprehensive understanding of the principles contained in that article. The IOC and IHO representatives offered to seek the publication of a book that would deal with the scientific and technical aspects of the law of the sea and address in greater detail the aspects described in the following few paragraphs.

17. While the actual bathymetric measurement is in some cases a prime requirement, in other cases the absolute depth may not be required. For instance, the slope of the sea floor can be determined from a profile of continuous depth measurements, or from a wide-angle imaging system that may not measure absolute depth. However, an isobath, a line connecting depth measurements all of which have the same known value, can only be derived from a system that measures absolute rather than relative depths.

18. Features such as oceanic and submarine ridges, plateaux, rises, caps, banks and spurs are recognized initially by their topographic form derived from depth measurements taken over a geographical area. However, the identification of some of these features, in particular oceanic and submarine ridges, and whether they could be considered as natural components of the continental margin, also requires a knowledge of their geologic composition.

19. The depth data submitted may be presented as a series of maps, charts, profiles or other graphics, or as digital data. The Commission may wish to know the quality of the data in each case. Maps and charts will normally be used as the first generalization of the information provided in the submission. In any graphic portrayal, whether it be on paper or another medium, several important factors govern the fidelity of the product.

20. The scale of graphics has a major effect on the presentation of the information: the larger the scale, the more details can be shown. The impression given by graphic presentation of profiles can vary greatly depending on the vertical exaggeration, that is, the ratio between the scale of the y-axis (usually water depth, sub-bottom depth) and that of the x-axis (usually distance). Scales can be chosen so as to emphasize or de-emphasize features such as the foot of the slope on a bathymetric profile or the apparent thickness of sediment on a seismic profile.

21. There is normally a large reduction in the amount of data from its raw state to a published graphic. Graphics of original data are normally produced at larger scales than the final presentation, and to present a smoothed and aesthetically pleasing appearance a generalization of complex features is usually made. Some data may be omitted and others added by interpretation,

interpolation and extrapolation where raw data do not exist. The quality, and therefore the reliability of the data presented in the graphic can only be judged by reference to the original data from which they are derived.

22. When examining graphic presentations, the Commission may wish to consider the purpose for which they were originally conceived. The two prime graphics of marine depth data are nautical charts and bathymetric (morphological) maps and profiles. The nautical chart is produced primarily for use in navigation and, owing to the concern for the safety of ships, their interpretation and presentation of data is biased towards emphasizing the shallower depths where ships could be in danger. Bathymetric maps prepared primarily for scientific use, or perhaps for the exploitation of marine resources, may take into consideration data other than bathymetric, as well as scientific hypotheses in their objective of showing the morphology (shape) of the sea floor as realistically as possible. Where such maps are prepared for ocean depths, only limited scientific data may be available owing to widely spaced survey tracks, in which case the graphics based on them may omit or over-interpret features. Only actual measurements in the previously unsurveyed ocean areas will eventually prove or disprove the hypotheses of a given graphic.

23. Maps showing the thickness of sediment on the continental shelf, or in the deep ocean, will also be very variable in the density of data used in their portrayal. In some areas of the continental shelf that have been the object of offshore oil and gas exploration, there will be extensive high-quality seismic data coverage, on the basis of which the thickness of sediment may be well established. Seaward of the geomorphological edge of the continental shelf limit, seismic data are likely to be much more sparse and, as with the bathymetric data, only actual measurements in unsurveyed areas will prove or disprove the validity of the graphic.

24. The Commission may request access not only to raw bathymetric and seismic data but also to the parameters that govern their accuracy. Such parameters include the quality of the horizontal positioning, the methods used to take the measurements and the variety of corrections that will have been used to refine the measurements. While cross-correlation of depth data from one survey line with that from intersecting or adjacent lines will provide some indication of quality, by exposing inconsistencies in measurement and processing, systematic errors or arbitrary datum shifts may still be present.

25. The quality of any bathymetric or sediment thickness graphic also depends on the accuracy in horizontal positioning of the data from which it was derived. In general, the more modern the navigation data, the better their accuracy. Until the end of the Second World War, the majority of vessels were positioned by astronomical means with accuracies typically of +/- 5 kilometres. In the 1950s, a variety of electronic positioning systems (e.g., loran, DECCA, OMEGA) became available. These systems relied on terrestrial transmitting stations, so that accuracy tended to be a function of distance from shore. At the outer limits of the continental shelf, accuracies of between 100 metres and 500 metres at best were obtained. In the 1970s, the Government of the United States of America developed positioning systems using polar orbiting satellite-based transmitters, and the accuracy of each derived position improved substantially, to +/- 100 metres, at best, in the dynamic mode. During the 1980s, the

Governments of the United States and of the Union of Soviet Socialist Republics developed, respectively, the Global Positioning System (GPS) and Global Navigation Satellite System (GLONASS), which today represent the most useful and accurate positioning systems. Further refinement of this technique, in so-called "differential GPS" mode, can provide positional accuracies as high as +/- 10 metres.

26. The quality of bathymetric data can only be evaluated if the parameters governing their determination are included. IHO publishes accuracy standards for depth measurement. 11/ Prior to around 1930, depths were measured by wire or even rope sounding lines, but since then, depths have for the most part been measured by acoustic means.

27. In its simplest form, an acoustic pulse is transmitted from a surface ship to the sea floor and the time for return to the surface is measured. A measured or assumed velocity of sound in sea water is used to convert that transmission time into water depth. Such acoustic depth measurements may be displayed as closely spaced spot measurements along the vessel's track or as a profile. In either case, the measurements are influenced by such factors as the density and the salinity of the water through which the signal is propagated, and the frequency and hence the beam width of the acoustic signal. The overall accuracy of a bathymetric graphic based on such data is a function of the spacing between the profiles that contribute to it.

28. By 1980, technology had advanced to imaging swaths of the sea floor by means of multi-acoustic beams, usually in a fan-shape. This greatly improved the coverage and decreased the need for interpolation, or interpretation, in representing the morphology of the sea floor. Where the swaths overlapped, this provided a complete picture of the sea floor. Although the advance from single profile to swath was significant, the propagation of acoustic signals through sea water is subject to errors resulting from the refraction of the outgoing signals. In addition, the stability of the measuring transducer (vessel) is critical since any motion changes the location on the sea floor from which the reflection is received.

29. Depth measurements obtained from precisely controlled, systematic hydrographic surveys normally provide the most accurate depth measurements over a given area. Since these are carried out primarily for the purpose of producing navigational charts on relatively shallow continental shelves rather than ocean waters, there is a paucity of such data for use in establishing the legally defined continental shelf. The majority of ocean depth data has been collected randomly during the passage of research and other vessels. In analysing such data, it is important to know the distribution of vessels' tracks, the systems used to collect the data, the time frames during which data were collected and the density of data along the track.

30. For over 20 years the acoustic-based technology of side-scan sonar has been available. Data from these systems primarily provide a qualitative description of sea-floor topography. Some modern systems use interferometric techniques to provide quantitative depth measurements by analysing the difference in response from two beams imaging the same point on the sea floor. However, since these systems transmit and receive signals at very oblique angles through the water

column, high accuracy is difficult to achieve. The accuracy in vertical depth deduced from such measurements depends on the accuracy of horizontal positioning and the attitude of the transducer.

31. The seismic reflection technique, upon which the majority of data on sediment thickness is based, is in its simplest form an extension of the acoustic method for measuring the depth of water. The transmission pulse is given the appropriate power and frequency to be reflected not only from the sea floor (and therefore provides bathymetric data itself) but also from the boundary between the various sedimentary layers or other geological features beneath the sea floor. The reflection times, when displayed in profile form, provide what appears to be a cross-section beneath the sea floor. However, given the uncertainties with regard to the velocity of propagation through the various layers beneath the sea floor, and refraction of the acoustic pulse throughout its transmission path, the profile contains many artefacts. Consequently, the interpretation of seismic data is a skilled art.

32. The earliest seismic reflection systems used explosives as the source and detected the return pulse with a single hydrophone. The sensitivity of such systems was improved by the addition of large numbers of hydrophones towed behind a ship in a long array, often 2 kilometres in length. These so-called multi-channel systems permitted the introduction of powerful methods of data processing that facilitated the removal of some of the artefacts. The difference in transmission path of the same pulse to different parts of the detection array also permitted the velocity of transmission in the different geological "layers" to be calculated. The accuracy of such velocity calculations depends, among other factors, on the geometry and attitude of the reflecting interfaces.

33. Changes in the nature of the seismic source also brought about improvements in the fidelity of the data collected. "Sparkers", in which the pulse is created by the discharge of an electrical pulse in the water, can be used to provide a high-resolution seismic profile, but with limited depth of penetration. "Air guns", powered by compressed air, can be tuned to produce a variety of acoustic pulses appropriate to the depth at which maximum resolution is required. Such systems have the added advantage of being more environmentally benign.

34. The velocity of transmission of the acoustic wave through the sub-bottom material is required not only to determine its thickness, but also to give an indication of the nature of the material. Lower velocities are generally associated with sedimentary material whereas higher velocities are often associated with metamorphic, igneous or "basement" material. A distinct change in velocities may mark the base of the sedimentary section, a significant measurement in the application of article 76.

35. Seismic refraction methods depend on the refraction of an acoustic wave into, and out of, a higher-velocity subsurface layer so that it travels over different but measurable path lengths within that layer. This permits the calculation of an "average" transmission velocity for that layer. By comparison with measurements made in boreholes, or on samples in the laboratory, the nature of the subsurface material may be deduced. However, because of the

uncertainties involved in the method, the cumulative uncertainty in velocity is likely to be greater than 10 per cent. The interpretation of thickness of the sediment column, or the physical nature of the geological material, is therefore open to considerable uncertainty. The Commission may therefore wish to have full details of the source of the data and the processing methods in order to determine the validity of the interpretation presented to it.

36. In recent years most depth, seismic reflection, and other data have been captured and stored in digital form. As with all data, the parameters describing such digital data are needed to evaluate them. The Commission may view their absence with suspicion. The Commission may also wish to scrutinize carefully the methods used to compile digital data into graphics since different approaches may yield markedly different results.

37. Contouring is often used in the presentation of data, but its methodology, such as the relative advantages of manual and automatic methods, is subject to much debate. Digital terrain models, in which a mathematically defined surface is determined as the best fit to the measured data, are used increasingly. All such methods interpolate the raw data to provide some form of useful graphic or numeric presentation. Depth or sediment thickness data in this form must therefore be evaluated bearing in mind the process used to convert raw data into a final product.

C. Requirements for, and analysis of, geodetic data

38. Article 76 (9) provides that the coastal State shall deposit with the Secretary-General of the United Nations charts and relevant information, including geodetic data, permanently describing the outer limits of its continental shelf. In the light of the accuracy of modern techniques, the use of charts for describing boundaries may be considered rather imprecise. The Commission may therefore request that geographical features be described in terms of geographic coordinates rather than graphically. In paragraphs 1, 4 (a), 5, 6 and 7 of article 76 there are requirements for points and lines to be determined by distances.

39. As the surface of the earth is irregular, approximating only in the first instance to a spheroid or ellipsoid, all computations should be carried out by geodetic means. All cartographic representations include some distortions. The practice of drawing straight lines or measuring distances on a chart or map must therefore be regarded with suspicion when precise measurements are expected. The Convention requires that the limits of the continental shelf be defined by straight lines connecting points that are defined in terms of geographic coordinates and that these control points must not be more than 60 nautical miles apart. Charts and maps may be used to effectively display features but not for precise positioning.

40. All points and lines must be defined with reference to a geodetic framework. Depending upon the geodetic horizontal datum used, the differences in location between sets of coordinates (latitude, longitude) referenced to different horizontal datums may be as great as 1,000 metres. For consistency, the Commission may decide that it would be better to have all continental shelf

limits referenced to one common datum. This requirement is particularly critical if there are conflicting submissions by two or more States. IHO recommends the international use of the WGS 84 datum but the task of converting charts and maps on a global basis to this reference may take many years to complete. In reaching its decision the Commission will have to take into account that some countries, Japan for example, are bound by their national laws to use a national datum.

41. Vertical datums are less critical than horizontal references. However, all depths must be referenced to a vertical datum plane. Depth data resulting from precise hydrographic surveys are normally referenced to a low-water datum. However, deep-water surveys are normally referred to mean sea level (MSL).

D. Considerations to be given with respect to satisfying the 200-nautical-mile rule

42. The 200-nautical-mile limit is defined with respect to baselines from which the breadth of the territorial sea is measured. The Convention assigns to the Commission no responsibility relating to the determination of baselines by the coastal State. Under the Convention, the coastal State has an obligation to deposit with the Secretary-General of the United Nations charts or lists of geographical coordinates establishing the position of the baselines for measuring the breadth of the territorial sea and of the limits derived therefrom, including the outer limit lines of the 200-nautical-mile exclusive economic zone.

43. If in determining the outer limit of the continental shelf the coastal State in certain areas applies the 200-nautical-mile line as the outer limit, then the coordinates of this 200-nautical-mile continental shelf line shall be the same as the coordinates of the 200-nautical-mile exclusive economic zone line which have been deposited with the Secretary-General. The coordinates of the baselines used for establishing these two lines must be the same.

E. Considerations to be given with respect to satisfying the rules relating to the foot of the continental slope

1. Sixty nautical miles from the foot of the continental slope

44. The Commission may wish to attempt to quantify the change in gradient that it considers significant in evaluating the "point of maximum change in the gradient at its base" (art. 76 (4) (b)). This will require definition of both the difference in gradient and the distance over which the two gradients are to be evaluated.

45. In evaluating the evidence given by a contour map, the Commission may wish to examine the data upon which the contour map is based, as well as the methods of interpretation and interpolation used to develop the contours (for data quality and density) in order to see whether it considers it sufficient to support the submission.

46. A determination of the "foot of the slope" based on original data may be different from a determination based on a contour map produced from the same data. The Commission will have to decide whether the evidence submitted for the location of the "foot of the slope" is appropriate.

47. The Commission will have to take into account the consequences of the different methods of collecting bathymetric data:

(a) Spot soundings, made with a wide-beam echo sounder, sample a large footprint covering a wide area of the sea floor. The sounding chosen will normally be the first acoustic return, which may be from a shallower depth some distance to the side of the track. Since this is a slant measurement, the measured depth will be greater than the true depth and will be incorrectly positioned, directly under the ship. Where wide-beam echo sounders are run continuously, giving an unbroken profile of depth, the same distortion of depth and position of shoal depths occurs;

(b) Narrow-beam echo sounders have been designed to reduce the size of the footprint. However, the beam is still of a finite width and in oceanic depths there will still be a significant distortion of the depth and position of shoal depths;

(c) Multi-beam echo sounder systems, particularly when each individual beam is narrow, provide accurate depths but data from such systems are relatively rare in deep water;

(d) Some multi-beam side-scan systems (e.g., 6.4 kHz wide-swath Geologic Long Range Inclined ASDic (GLORIA) system) 12/ capture sea floor morphology but not an accurate depth of the sea floor. The Commission will have to decide whether the morphology of the sea floor can be used to locate the foot of the slope under the terms of article 76 (noting that identification of the foot of the slope does not require knowledge of its absolute depth);

(e) Satellite altimetry is now being used to produce predicted bathymetric maps - again primarily morphology rather than absolute depth. The Commission will have to decide how it will treat such data (on its own, or as an interpolation tool) given the effective footprint of the measuring system;

(f) Seismic reflection data can also be used as a source of bathymetric data, because the water bottom is always a high-contrast feature on seismic profiles.

48. Bathymetric charts will often be produced from a combination of all such types of data. The Commission must consider whether it needs access to the source data in order to assess their validity.

49. The Commission should consider whether its recommendations with respect to article 76 may benefit from further surveys by the coastal State because the information submitted is inadequate, taking into account the consequent expense, time and potential delay.

50. The Commission in its deliberations may wish to take into account the following:

(a) The majority of the world's high-quality, unclassified hydrographic data were collected for "safety of navigation" reasons on the continental shelf; hence such data are generally not available where they are most needed in the implementation of article 76, i.e., seaward of the shelf edge;

(b) Navigation charts, derived from hydrographic data collected for "safety of navigation", preferentially display depth minima rather than the morphology of the sea floor;

(c) Much of the unclassified bathymetric data collected beyond the edge of the continental shelf are poorly measured with poor horizontal position control.

51. The Commission must deal with, inter alia, the following questions:

(a) Has the State given "evidence to the contrary" against using the foot of the slope as defined in article 76?

(i) Is that evidence acceptable to the Commission?

(ii) Does that evidence pertain to the identification of the foot of the slope? Is that evidence purely bathymetric and/or morphological?

(iii) Does that evidence include subsurface information aimed at establishing that the limit obtained by the basic formula would not, for example, equate to the limit of the geological continental margin?

(iv) If such "evidence to the contrary" is presented as part of a submission, the Commission may wish to ask that it also be accompanied by the results of applying the formula. Without such a request, a coastal State might make a submission that does not comply with the majority of the provisions of article 76.

(b) Has the State determined the "foot of the continental slope" as the "point of maximum change in the gradient at its base"?

(i) What database has been used?

(ii) Have contour maps or profiles been used?

(iii) If contour maps were used, is the survey control adequate/acceptable for definition of the limits of the shelf by straight lines not exceeding 60 nautical miles in length?

(iv) If profiles were used, are they close enough to provide for definition of the limits of the shelf (not the foot of the slope) by straight lines not exceeding 60 nautical miles in length? Is the location of the point of maximum change of gradient at its base appropriately determined, recognizing, for example, the impact of using different vertical exaggerations in presentation, or the consequences of line

separation on the use of an automatic scheme that may have been used to determine the point of maximum change of gradient?

(c) Has the 60-nautical-mile extrapolation from the foot of the slope been calculated correctly, including use of the correct geodetic computational method?

(i) Are the coordinates of the outer continental shelf limit correctly and uniquely identified?

(ii) Are they presented in an acceptable form?

(iii) Are the turning-points specified in coordinates of latitude and longitude less than 60 nautical miles apart?

2. A line delineated by reference to the outermost fixed points where the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope

52. In applying the sediment-thickness formula, the Commission will have to address the identification of the sediment/basement interface, the calculation of sediment thickness and the variability of sediment distribution. Basement may be identified either qualitatively (according to its character on seismic reflection records) or quantitatively (according to the velocity with which seismic waves travel within it). The thickness of sedimentary rocks is derived from the travel time of an acoustic wave through them. To convert that travel time into thickness, the velocity of propagation within that material needs to be determined accurately. The velocity of the seismic signal through the sedimentary section can be calculated during the processing of multi-channel seismic data, but because of uncertainties involved in the procedure, inaccuracies in the calculated sediment thickness, could typically be 10 per cent. An error in velocity translates into an error in thickness which translates into an error in the distance from the foot of the slope that may properly be part of the submission.

53. It should be noted that the digital seismic data should be processed to a reasonable level of quality and that details of the processing shall be provided. The vertical scale should be in "time", not in "depth", and should be annotated with respect to the horizontal scale. Velocity data should be submitted as well. Unmarked as well as interpreted sections may be requested by the Commission.

54. The Commission may consider giving different weight to multi-channel data, with their accompanying, but inherently somewhat inaccurate, velocity information, compared with single-channel data, without velocity information.

55. In considering the quality and quantity of the sedimentary velocity information used in the submission, the Commission may wish to note that velocities can be obtained by the following methods:

(a) Velocity surveys carried out in boreholes (in situ);

(b) Analysis of cores drilled from the sedimentary section. Such measurements are accurate, but rare, and are only locally significant;

(c) Velocity analysis from multi-channel seismic reflection data. Such results are only valid to a depth that is related to the length of the receiver array, and are more accurate at shallower depths;

(d) Seismic refraction and wide-angle reflection surveys can be used to obtain the velocities of deeper layers, but the derived velocities are averaged over the length of the refraction spread.

The validity with depth and lateral resolution of velocity data is therefore highly variable.

56. The Commission will have to take into account the characteristics of different systems and bear in mind their respective accuracies in the various situations considered: (a) extensive but inherently somewhat inaccurate data obtained from velocity analyses from multi-channel surveys; (b) few good, but spatially averaged data obtained from good refraction surveys; (c) intermediate-quality data obtained from sonobuoy refraction surveys.

57. When a map is submitted to it, the Commission should recognize that the data upon which it is based are subject to the same uncertainties identified herein. The Commission may therefore wish to consider the adequacy of the underlying basic data.

58. The following questions may well be addressed by the Commission at the initial stage of deliberations:

(a) What is the database for sedimentary thickness?

(b) If a contour map has been used, is the survey control adequate/ acceptable for definition of the limits of the shelf every 60 nautical miles?

(c) If profiles have been used, are they close enough to provide for definition of the limits of the shelf every 60 nautical miles?

(d) What is the evidence for basement beneath the sediment:

(i) Drill core? Definitive parameter;

(ii) Seismic character? Qualitative parameter;

(iii) Seismic velocity? Quantitative parameter.

Were these data obtained by refraction, or velocity analysis from multichannel data, or sonobuoys?

(iv) Gravity, magnetics or other geophysical data? Indirect and interpretive.

59. The Commission will have to determine, in each case, the weight it gives to the different types of evidence. It will have to check whether errors have occurred in calculating the sedimentary thicknesses and, if so, whether they were attributable solely to the available velocity control.

60. The Commission will have to verify whether the sedimentary extrapolation has been applied correctly from the location of the foot of the slope. Are the coordinates of the outer continental shelf limit correctly and uniquely identified in the correct geodetic reference system as coordinates of latitude and longitude less than 60 nautical miles apart?

F. Considerations to be given with respect to satisfying the rule on limiting lines

1. 350 nautical miles from the baselines

61. As pointed out in paragraph 42 above, the Convention does not assign to the Commission any responsibility relating to determination of baselines by the coastal State. The coastal State has an obligation to deposit with the Secretary-General charts or lists of geographical coordinates establishing the position of the baselines and of the limits derived therefrom. The geographical coordinates of the baselines used for the determination of the 350-nautical-mile limit shall be the same as those deposited with the Secretary-General.

62. The Commission will have to verify whether the 350-nautical-mile extrapolation has been calculated correctly, using the correct geodetic computation methods and reference system, and that the coordinates of any 350-nautical-mile line have been correctly and uniquely identified as coordinates of latitude and longitude less than 60 nautical miles apart.

2. 100 nautical miles seaward of the 2,500-metre isobath

63. Under article 76 (5) and (6), the limit of 100 nautical miles seaward of the 2,500-metre isobath cannot be applied to shelf limits on submarine ridges, except where they are natural components of the margin, such as its plateaux, rises, caps, banks and spurs.

64. The Commission will have to address the following questions:

(a) Is the limit being proposed on a submarine ridge? If not, go to subparagraph (c). If yes, go to subparagraph (b);

(b) Has the coastal State given convincing evidence that the submarine ridge is a "natural component of the margin"? If yes, continue. If not, this limit is not applicable;

(c) How is the 2,500-metre isobath determined?

(d) What database has been used?

(e) Which navigation systems, with what accuracies, were used in the collation of the bathymetric data?

(f) How will small closures of the 2,500-metre isobath lying outboard of a more continuous, margin-parallel 2,500-metre isobath be handled?

(g) What sound velocity data have been used to "correct" the echo sounding data and how accurate are they?

(h) If a contour map has been used, is the survey control adequate/ acceptable for definition of the limit of the shelf every 60 nautical miles?

(i) If profiles have been used, are they close enough to provide for definition of the limit of the shelf (not the 2,500-metre isobath) every 60 nautical miles? If the profiles cross the 2,500-metre isobath several times, which is the reference isobath?

(j) Has the 100-nautical-miles extrapolation from the 2,500-metre isobath been calculated correctly, using the correct geodetic reference system?

(k) Have the coordinates of the limit been submitted correctly and identified uniquely?

(l) Are the coordinates specified in coordinates of latitude and longitude less than 60 nautical miles apart?

III. SUGGESTED FORMAT AND DISPOSITION OF MATERIAL USED AS PART OF A SUBMISSION

65. Under article 76 (9), the coastal State is obligated to deposit with the Secretary-General "charts and relevant information, including geodetic data, permanently describing the outer limits of its continental shelf". Article 4 of Annex II requires that "scientific and technical data" be submitted to the Commission in support of a limit beyond 200 nautical miles. Are these data to be shown to, but not retained by, the Commission? This has relevance to the degree of the security/confidentiality of proprietary, or confidential, data that can be guaranteed to the coastal State by the Commission.

66. The Commission will have to decide who determines the format of the data and information submitted. If the coastal State chooses the format, the Commission will have to be able to handle and analyse a multiplicity of varying types of information that will be submitted. If the Commission establishes the format of the data and information, while not restricting the freedom of the coastal State to present adequate valid data, it may wish to specify the following as recommendations:

(a) The types of map compilations and cross-sections to illustrate the essential aspects of and basis for the submission. This might include, for example, a map of the continental shelf limits, indicating the criteria on which they are based, and the geological, geomorphological and bathymetric features relevant to the submission;

(b) The projections, range of scales and contour intervals of charts and maps;

(c) The acceptable range of scales of profiles, both horizontal and vertical;

(d) That copies of all published supporting material (e.g., charts, profiles, analyses, articles, etc.) be provided;

(e) The numbers of copies of each supporting item that it wishes to receive;

(f) The desirability of having appropriate data in digital form wherever possible for ease of reference and examination.

67. The Commission will have to decide the degree to which it may wish to exchange information with IOC, IHO and other organizations, where such an exchange may be of assistance in discharging its responsibilities. This may determine the degree to which a coastal State may wish to use proprietary or confidential data in support of its continental shelf limits.

68. The Commission may wish to consider the preparation and distribution of a guide or check-list of information that it considers appropriate to be part of a submission. A draft of such a check-list is included in annex I to the present study. It was prepared to stimulate consideration of these issues by the Commission. In this regard the Commission may wish to consider that:

(a) The document will have an impact on how the Commission proceeds;

(b) The quantity and type of information deemed satisfactory will determine the surveys and analysis that a coastal State needs to carry out;

(c) The requirement for a coastal State to submit its continental shelf limits within 10 years of entry into force of the Convention for that State makes it desirable that the recommendations of the Commission regarding the format for submission be published as soon as possible;

(d) The experience gained from discussions that members of the Commission have with States Parties to the Convention will be useful in clarifying the standards to be set for submissions.

69. The Commission may wish to consider stating that no map shall be submitted to it unless it is supported by the database, preferably in digital form, from which it is derived.

70. The Commission must be mindful of existing or potential offshore boundary disputes between opposite or adjacent coastal States and the proviso in article 76 (10) of the Convention, which states that "[t]he provisions of this article are without prejudice to the question of delimitation of the continental shelf between States with opposite or adjacent coasts".

71. It is anticipated that the Commission will request that each submission should contain an inventory of the items that are being submitted. This will include the sources of the data (e.g., cruise name, existing atlas, etc.), together with their dates of collection. The Commission may consider suggesting that the submission include the information given in paragraphs 72 to 85 below.

72. An important part of any package should be a series of maps which ties all the data submitted into a common geographic frame of reference. The Commission may request that the scale and projection for all submitted maps or groups of submitted maps (ships' tracks, bathymetry, sediment isopach maps, depth of basement, as well as other possible maps, such as magnetic anomaly maps, gravity maps and maps of wide-angle reflection/refraction lines) should be the same.

73. Latitude and longitude should be clearly marked on maps. It should be clear whether the units are degrees/minutes or decimal degrees. Maps should be large enough so that details of the cruise tracks are visible and track annotations are legible.

74. Navigation and data records should be annotated in the same units. Multi-channel seismic reflection lines (MCS) are usually annotated in shot points, common depth points (CDPs), 13/ or both; these are not interchangeable. Care must be taken to distinguish one from the other, and each should be labelled clearly.

75. Multi-channel seismic data should be processed to at least the necessary level of quality to justify the particular approach used. A description of the processing should either appear on the seismic line or be included in the package of information submitted to the Commission. This should also include information on the cruise or ship on which the data were collected and the dates of collection and of processing of the data.

76. Seismic lines must be tied to a navigation plot which is annotated in the same units as the seismic line (shot points, CDP). Seismic lines should have a vertical scale in seconds, an indication of direction and an indication of horizontal distance. Unmarked copies of the seismic lines are needed, together with an interpretation of the submitted seismic line to emphasize the interpreted feature such as the contacts between sedimentary units, top of basement, etc.

77. The format for analog records is essentially the same as for digital seismic records. The records are often annotated with time-of-day, and navigation data with this annotation need to be provided. Vertical and horizontal scales should be noted, as well as an indication of the direction of the profile.

78. Bathymetric data are often tied to position by time (time-of-day). If this is the case, then the track lines should be annotated with time(s) (time-of-day).

79. Single-beam bathymetric data may be available as isolated soundings, as a series of soundings at discrete intervals along a ship's track or as a continuous profile along the track and may be presented as a series of depth

profiles, as a map/chart detailing soundings as figures (measured or interpolated), or as a map/chart depicting depth contours (based on real or interpolated data). The units of measurement must be stated along with the contour interval where appropriate, and it must be possible to identify specific contours clearly. The vertical reference datum should be stated.

80. The displayed depths may be uncorrected, corrected or referred to a standard speed of sound through water, such as 1,500 metres per second. The method of correction for the speed of sound in water should be stated.

81. The source of the data should be shown (where available) since this is likely to affect the quality of the positioning and depth measurements.

82. Multi-beam bathymetric data should be processed as much as possible to represent the correct depth. Spurious depth measurements should have been edited out. The data presented to the Commission may be a thinned out/gridded subset of the original data but it should be supported by a full description of the processing and details of any thinning/interpolation that has been carried out.

83. Where synthetic depth profiles at right angles to the foot of the slope have been constructed from gridded or non-continuous data, this should be clearly stated and the methodology fully described.

84. Where bathymetry has been inferred by means other than single-beam or multi-beam echo sounder (e.g., satellite altimetry, side-scan sonar interferometry or seismic reflection), this should be clearly stated and the method of processing fully detailed.

85. The accurate conversion of milliseconds of reflection time on seismic profiles to predicted metres of sub-sea floor depths is essential for applying the sediment-thickness formula. Therefore, seismic velocity data, including a brief description of how they were derived, where they apply and an estimate of their accuracy, should be submitted. The data presentation should include a graph of two-way travel time (reflection time) below sea floor versus calculated metres below sea floor.

IV. A CONCEPTUAL MODUS OPERANDI FOR THE COMMISSION

86. The following represents one possible operational approach that the Commission could choose to adopt:

(a) Initial submission by a coastal State to the Commission, through the Secretary-General of the United Nations, of particulars of the outer limits of its continental shelf beyond 200 nautical miles in accordance with article 76 of the Convention, together with supporting scientific and technical data. It would be preferable at this first submission stage for the coastal State to present in its package summary A4 maps 14/ indicating the approximate limits of its continental shelf, its territorial sea baselines, the general manner by which the limits were defined and any potential areas of disagreement with other

States. This initial submission will be an executive summary of the full submission to be considered by a subcommission;

(b) Following the initial submission, there needs to be a period of several months prior to the first formal consideration of the submission by the Commission. This allows for due publicity to be given to the submission through the United Nations notification process using the summary maps included in the executive summary;

(c) A full sitting of the Commission at United Nations Headquarters to consider the initial submission of the coastal State, to identify any potential problems and, if possible, select the location for future more detailed consideration of the submission by a subcommission. The coastal State may choose to send its representatives to participate in these proceedings without the right to vote;

(d) Establishment of a subcommission of the Commission consisting of seven members appointed in a balanced manner, in accordance with Annex II, article 5, of the Convention, and drawing together the most appropriate expertise from Commission members to examine the particular submission. The best time for this to be done would be at the end of the first full sitting of the Commission following consideration of the submission, taking into account the range of expertise that will be required for more detailed consideration of the submission. This would allow early designation of the members of the Commission who will be involved in the further examination of a submission in a subcommission. Detailed information supporting the submission can be given to these members for further consideration at this stage;

(e) A meeting of the subcommission at the most appropriate location to ensure that a detailed, full and fair consideration of the submission can be carried out. Once again, the coastal State may choose to have its representatives participate in these proceedings;

(f) In the case of a very detailed and technology-intensive submission requiring special software/hardware to examine the information in the most efficient way, it is likely that the best location for a meeting of a subcommission will be at the lead technical agency for the coastal State. However, in the case of a submission that is lacking in detailed information, it may be more appropriate for the subcommission to meet at a location where relevant data sets may be available (e.g., IHO, Monaco; National Geophysical Data Center (NGDC), Boulder, Colorado, United States) to support a full consideration of the submission. In other cases, where all the information has been assembled in a manageable form, it may be more appropriate to meet at United Nations Headquarters. There appear to be considerable advantages in some situations in the subcommission's meeting in the coastal State concerned. In particular:

(i) The technology and support staff that the State used in compiling, interpreting and presenting data to support its submission will be readily available;

(ii) All relevant data will be quickly accessible;

(iii) Local experts will be available for detailed discussions should the need arise;

(iv) Sophisticated and confidential data sets can be stored and maintained in the coastal State;

(v) Large supporting data sets will not need to be stored and maintained at United Nations Headquarters;

(vi) Countries with only minimal access to databases and information can be advised by the subcommission at this stage, if it is appropriate;

(vii) Costs to the submitting coastal States may be reduced to some extent because there will be less need for massive copying of data sets, and they will not have to send their representatives to meetings in New York;

(g) The subcommission submits its recommendation on the submission to the full Commission, initially in the form of a report;

(h) A meeting of the full Commission at United Nations Headquarters is convened for final consideration of the subcommission's recommendations. In accordance with Annex II, article 6 (2), of the Convention, approval by the Commission of the recommendations shall be by a majority of two thirds of Commission members present and voting;

(i) The recommendations of the Commission are submitted in writing to the coastal State that made the submission, and to the Secretary-General of the United Nations (Annex II, art. 6 (3));

(j) In the case of disagreement by the coastal State with the recommendations of the Commission, the coastal State shall, within a reasonable time, make a revised or new submission to the Commission (Annex II, art. 8).

V. TECHNICAL RESOURCES NEEDED BY THE COMMISSION

87. The Commission may wish to request that the following reference materials, equipment and facilities be made available to it to assist its members in their deliberations. Similar material may be useful for those coastal States preparing a submission to the Commission. The United Nations Dag Hammarskjöld Library and its branches may contain other useful reference material that would be available to the Commission when working in New York. Additional specialist reference books might also be available locally, e.g., from the Lamont Doherty Geological Observatory, Palisades, New York. More than 20,000 charts are available for reference purposes in the International Hydrographic Bureau in Monaco. It would also be useful to prepare a glossary of technical terms, including all technical terms mentioned in the provisions of the Convention relating to the continental shelf, as well as terms included in typical submissions by coastal States and recommendations of the Commission.

(a) Technical library:

(i) Lexicons:

a. Glossary of Geology, Bates and Jackson (eds.) (American Geological Institute).

b. Dictionary of Geological Terms (American Geological Institute).

c. Encyclopedic Dictionary of Exploration Geophysics, by R. Sheriff (Tulsa, Oklahoma: Society of Exploration Geophysicists, 1991).

d. Hydrographic Dictionary, Publication No. 32, 5th ed. (Monaco: International Hydrographic Bureau).

(ii) Technical reference books:

a. Encyclopaedia of Solid Earth Sciences (Oxford: Blackwell Scientific Publications, 1993).

b. A Manual on Technical Aspects of the United Nations Convention on the Law of The Sea - 1982. Special Publication No. 51, 3rd ed., July 1993 (International Hydrographic Bureau, Monaco, 1993).

c. Admiralty Manual of Hydrographic Surveying. 2 vols. (London: Hydrographer of the Navy, 1965).

d. Watkins, J. S., and C. L. Drake (eds.). Studies in Continental Margin Geology. American Association of Petroleum Geologists. Memoir 34, 1982.

e. Wells, W. (ed.). Mapping the Continental Shelf Limit: Legal/Technical Interface (Fredericton, New Brunswick: University of New Brunswick, 1994).

f. Emery, K. O., and E. Uchupi. The Geology of the Atlantic Ocean (New York: Springer-Verlag, 1984).

g. Shalowitz, Aaron L. Shore and Sea Boundaries: with special reference to the interpretation and use of coast and geodetic survey data. 2 vols. (Washington, D.C.: United States Department of Commerce, vol. 1, 1962; vol. 2, 1964).

h. Tankard, A., and H. Balkwill (eds.). Extensional tectonics and stratigraphy of the North Atlantic margins. American Association of Petroleum Geologists. Memoir 46, 1989.

i. Bally, A. W. (ed.). Seismic Expression of Structural Styles (American Association of Petroleum Geologists, 1983).

j. Speed, R. C. (ed.). Phanerozoic Evolution of the North American Continent - Ocean Transitions and the Continent. Ocean transects to which it refers (Geological Society of America, 1994).

k. Kuenen, Philip Henry. Marine Geology (New York: Wiley, 1950).

l. Brown, Curtis M., Walter G. Robillard, and Donald A. Wilson. Boundary Control and Legal Principles (New York: Wiley, 3rd ed., 1986; 4th ed., 1995).

m. Boggs, S. Whittmore. International Boundaries: A Study of Boundary Functions and Problems (New York: Columbia University Press, 1940).

n. Luard, David Evan Trant (ed.). The International Regulation of Frontier Disputes (London: Thames and Hudson, 1970).

o. Pharand, Donat. The Law of the Sea of the Arctic: with special reference to Canada (Ottawa: University of Ottawa Press, 1973).

p. Bowett, Derek W. The Legal Regime of Islands in International Law (Dobbs Ferry, New York: Oceana, 1979).

q. Publications of the International Hydrographic Organization on the following subjects:

- Chart Specification;
- Precise Positioning Systems;
- Standard for Hydrographic Surveys;
- Correction of Echo Soundings;
- Tidal Constituent Bank;
- Bathymetric Data;
- User's Handbook on Datum Transformation.

(iii) Charts and data sets:

a. General bathymetric chart of the oceans (GEBCO), 5th ed., 1982. Full set (16 Mercator sheets, 1:10,000,000, 2 polar sheets 1:6,000,000); GEBCO Digital Library (CD-ROM), 5th ed.;

b. Naval Research Laboratory maps, e.g., Bathymetry of the Arctic Ocean;

c. Chart catalogues of the national hydrographic offices of the United States, the United Kingdom and the Russian Federation;

d. Coastlines - Digital chart of the world (DCW) and Defense Mapping Agency's (DMA) World Vector Shoreline (WVS) and World Databank II (WDBII);

e. GEOphysical DAta System (GEODAS) CD-ROM and other relevant data sets and charts of the National Geophysical Data Center (NGDC), Boulder, Colorado (some accessible through Internet/WWW);

f. Geological References (GEOREF) CD-ROM (available from the American Geological Institute (AGI), Alexandria, Virginia);

g. TerrainBase CD, 5-minute digital terrain data of land and ocean values;

h. A general reference atlas such as the Times Atlas of the World.

(b) Computers and related equipment:

Guidelines proposed below are for equipment set-up to enable the Commission to review and analyse data in at least three different formats (DOS/Windows, Mac OS, UNIX) submitted by coastal States, and for generating hard copies of data and archiving:

(i) One workstation to be configured with an IBM-compatible PC, Pentium processor 150+ mHz, 64Mb RAM, 4Mb V-RAM, 2Gb hard drive, math co-processor, CD-ROM drive, iomega Zip drive, external Ditto 3.2Gb tape drive, external read/write CD drive, network connectors, modem/Internet hook-up, high resolution 21" colour monitor with appropriate graphics card, extended keyboard/mouse;

(ii) One workstation to be configured with a Macintosh 9500 Power PC, 64Mb RAM, 4Mb V-RAM, 2Gb hard drive, math co-processor, CD-ROM drive, iomega Zip drive, external Ditto 3.2Gb tape drive, external read/write CD drive, network connectors, modem/Internet hook-up, 21" high resolution colour monitor with appropriate graphics card, extended keyboard/mouse;

(iii) One Sun workstation (see above);

(iv) Two laptop computers, IBM ThinkPad 365XD, or similar;

(v) One desktop colour laser printer, HP DeskJet 1600CM with additional memory (16Mb+) and appropriate hook-ups to all workstations, or similar;

(vi) One large format plotter, HP650C with additional memory (64Mb) and appropriate hook-up to all workstations, or similar;

(vii) Software package should include word-processing programmes, a GIS programme such as MapInfo or DeLorme X-Map, various software interfaces for products like the GEBCO Digital Atlas, a relational

database programme such as Paradox or FoxPro, and a graphic arts programme such as Adobe Illustrator;

(viii) It is important to note that coastal States submitting digital data should either include or identify the software programme that generated it;

(ix) Microfiche reader.

(c) Facilities:

(i) Layout and analysis space: The subcommissions, in particular, will need space and drawing/light table on which they can lay out and examine the material submitted in support of a proposed limit. Subsets of these data will be needed when the Commission examines the findings of the subcommission;

(ii) Storage: Secure and fireproof storage systems would be required for the filing of documents, microfiches, CDs, computer tapes and maps, and shelf space for the technical library.

Notes

1/ United Nations Convention on the Law of the Sea, Annex II, article 2, paragraph 2.

2/ SPLOS/5, para. 20.

3/ United Nations Convention on the Law of the Sea, Annex II, article 3, paragraph 1.

4/ Ibid., Annex II, article 2, paragraph 3.

5/ Ibid., Annex II, article 2, paragraph 1.

6/ Ibid., Annex II, article 2, paragraph 5.

7/ Ibid., Annex II, article 6, paragraph 3.

8/ Ibid., article 76, paragraph 8.

9/ Ibid., Annex II, article 8.

10/ The Law of the Sea. Definition of the Continental Shelf: An Examination of the Relevant Provisions of the United Nations Convention on the Law of the Sea (United Nations publication, Sales No. 93.V.16).

11/ IHO Standards for Hydrographic Surveys and Classification Criteria for Deep Sea Soundings, International Hydrographic Organization Special Publication No. 44.

12/ The acoustic method of remote detection was originally developed for the detection of submarines by the Allied Submarine Detection Investigation Committee (ASDic).

13/ Common depth point (CDP) is the point from which the maximum number of reflections is received by a seismic vessel. It is halfway between the source and the final geophone.

14/ "A4" refers to a particular standard metric size of paper, 21 cm by 30 cm. A3 is twice the area of A4, while A5 is half the A4 size.

ANNEX I

Information that the Commission may wish to consider requesting as part of a submission by a coastal State

1. As indicated in paragraph 68 of the study, the Commission may wish to consider the preparation and distribution of a guide or check-list for data that it might suggest as being appropriate to include as part of a submission. The following draft listing is offered to stimulate consideration of these issues by the Commission.

2. The submission in support of a limit to the continental shelf of a coastal State may include one of eight possible cases at any point along the limiting line:

1: 200 nautical miles seaward of the baseline (in accordance with article 76 (1)). This limit is not subject to any overriding limits;

2: 60 nautical miles seaward of the foot of the slope (in accordance with article 76 (4) (a) (ii)). This limit may be subject to one of two overriding limits (in accordance with article 76 (5)):

2 (a): 350 nautical miles seaward of the baseline;

2 (b): 100 nautical miles seaward of the 2,500-metre isobath;

3: The line along which the sediment thickness is 1 per cent of the distance from the foot of the slope (in accordance with article 76 (4) (a) (i)). This limit may be subject to one of two overriding limits (in accordance with article 76 (5)):

3 (a): 350 nautical miles seaward of the baseline;

3 (b): 100 nautical miles seaward of the 2,500-metre isobath;

4: A limit agreed to by States with opposite or adjacent coasts (in accordance with article 83).

3. For each of these cases, the Commission may wish to request that it be provided with the information indicated under the corresponding case code in the table below:

- "M" indicates that provision of this information is mandatory in order that the Commission and the subcommission may discharge their responsibilities;

- "O" indicates that provision of this information is optional in order to assist the Commission and the subcommission in discharging their responsibilities.

Type of information to be submitted	Cases for which this information is to be submitted							
	1	2	2a	2b	3	3a	3b	4
Limit of overall continental shelf for coastal State (map)	M	M	M	M	M	M	M	M
Limit of continental shelf for different parts of the margin (larger-scale maps)	M	M	M	M	M	M	M	M
Criteria by which the limit is defined, each of the eight criteria being indicated by a coded line (map)	M	M	M	M	M	M	M	M
Baselines used in defining the limit if not shown on the limit maps (map)	M		M			M		O
Baselines used for different parts of the margin (larger-scale maps)	M		M			M		O
200-nautical-mile limit (map)	M							
350-nautical-mile limit (map)			M			M		
Location of the foot of the slope (FOS), specifying how determined (map)		M	M	M	M	M	M	
Lines used to determine FOS (map), showing line identifier, navigation, shot points, etc., including the 60-nautical-mile extension line		M	M	M	M	M	M	
Lines used to define the 2,500-metre isobath (map), showing line identifier, navigation, shot points etc.				M			M	
Bathymetric contours (map):								
- Where it identifies the 2,500-metre isobath				M			M	
- Where not used as the basis for FOS		O	O	O	O	O	O	
- Where used as the basis for FOS		M	M	M	M	M	M	
FOS base points used for 60-nautical-mile extrapolation (map)		M	M	M				
All bathymetric profiles (sections) annotated with locations of the interpreted FOS:								
- Where used as the basis for FOS		M	M	M	M	M	M	
- Where not used as the basis for FOS		O	O	O	O	O	O	

Type of information to be submitted	Cases for which this information is to be submitted							
	1	2	2a	2b	3	3a	3b	4
Representative bathymetric profiles (sections) annotated with the location of the interpreted FOS to indicate the character of the margin		O	O	O	O	O	O	
Bathymetric survey parameters (table) keyed by cruise or line identifier showing reliability of FOS and 2,500-metre isobath, including sound velocity used and accuracy of location and velocity/depth profiles		M	M	M	M	M	M	
Digital multi-channel seismic tracks (map) used in determination of sediment thickness, including shot point numbers and navigation					M	M	M	
Analog single-channel seismic tracks (map) used in determination of sediment thickness, including shot point numbers and navigation					M	M	M	
FOS points used to derive the 1 per cent sediment thickness points (map)					M	M	M	
Seismic profiles (travel time sections) used to determine sediment thickness (two copies: one original, one interpreted)					M	M	M	
Representative seismic profiles (travel time sections) used to determine sediment thickness (two copies: one original, one interpreted) to indicate character of margin					O	O	O	
Travel time difference between sea floor and basement (map):								
- If 1 per cent points based on isopachs					M	M	M	
- If 1 per cent points based on profiles					O	O	O	

Type of information to be submitted	Cases for which this information is to be submitted							
	1	2	2a	2b	3	3a	3b	4
Sediment thickness (map) showing depth-converted versions of travel time difference maps:								
- If 1 per cent points based on isopachs					M	M	M	
- If 1 per cent points based on profiles					O	O	O	
Survey parameters keyed to seismic profiles (table), including the acquisition method, time/depth conversion table/plot and accuracy indicators for location and velocity					M	M	M	
Velocity analyses (table) on which time/depth conversion was based					M	M	M	
Location of all data used as basis for velocity analyses (map), indicating whether refraction, ocean bottom seismometer, sonobuoy, borehole, wide-angle reflection or other method was used					M	M	M	
All depth-converted profiles (sections or horizon plots) annotated to show sea floor, basement surface, FOS and 1 per cent point:								
- If 1 per cent points based on profiles					M	M	M	
- If 1 per cent points based on isopachs					O	O	O	
Representative depth-converted profiles (sections or horizon plots) annotated to show sea floor, basement surface, FOS and 1 per cent point to indicate the character of the margin					O	O	O	

4. Copies of each of the sets of information listed above will be required for examination by different groups throughout the submission and review procedure. In the study it is suggested that:

(a) The Commission may operate out of New York and will review an executive summary of the submission only in order to appoint a subcommission, in which case 21 copies of the executive summary will be required (see para. 86 (a) of the study);

(b) The subcommission may operate in the coastal State (or at a location of the coastal State's choice), in which case each of the seven members of the subcommission will need an advance copy of the maps and sections upon which the submission is based in order to decide what detailed data sets it will wish to view in the location chosen by the coastal State.

5. If the Commission and the subcommission operate in this way, copies of each of the sets of information listed above will need to be accessible as follows:

(a) To the Commission ("C" in the table below), which will receive the submission and appoint a subcommission;

(b) To the subcommission ("S"), which will examine the submission;

(c) To the coastal State ("St"), in presenting the submission;

(d) At a laboratory ("L") holding data that the subcommission may wish to examine, but copies of which may not be held by the coastal State. This will in general be either highly detailed or indirect supporting data, e.g., digital multi-channel seismic data, world gravity database.

In the following table:

- "M" indicates that provision of this information is mandatory in order that the Commission and the subcommission may discharge their responsibilities;

- "O" indicates that provision of this information is optional in order to assist the Commission and the subcommission in discharging their responsibilities.

Type of information to be submitted	Who must have access to this information			
	C	S	St	L
Limit of overall continental shelf for coastal State (map)	M	M	M	
Limit of continental shelf for different parts of the margin (larger-scale maps)	O	M	M	
Criteria by which the limit is defined, each of the eight criteria being indicated by a coded line (map)	M	M	M	
Baselines used in defining the limit if not shown on the limit maps (map)	M	M	M	
Baselines used for different parts of the margin (larger-scale maps)	O	M	M	
200-nautical-mile limit (map)	M	M	M	
350-nautical-mile limit (map)	M	M	M	
Location of the foot of the slope (FOS), specifying how determined (map)	M	M	M	
Lines used to determine FOS (map), showing line identifier, navigation, shot points, etc., including the 60-nautical-mile extension line	M	M	M	
Lines used to define the 2,500-metre isobath (map), showing line identifier, navigation, shot points, etc.	M	M	M	
Bathymetric contours (map):				
- Where it identifies the 2,500-metre isobath	M	M	M	
- Where not used as the basis for FOS	O	O	O	
- Where used as the basis for FOS	M	M	M	
FOS base points used for 60-nautical-mile extrapolation (map)	M	M	M	
All bathymetric profiles (sections) annotated with locations of the interpreted FOS:				
- Where used as the basis for FOS		M	M	O
- Where not used as the basis for FOS		O	O	O
Representative bathymetric profiles (sections) annotated with the location of the interpreted FOS to indicate the character of the margin	M			

Type of information to be submitted	Who must have access to this information			
	C	S	St	L
Bathymetric survey parameters (table) keyed by cruise or line identifier showing reliability of FOS and 2,500-metre isobath, including sound velocity used and accuracy of location and velocity/depth profiles		M	M	O
Digital multi-channel seismic tracks (map) used in determination of sediment thickness, including shot point numbers and navigation	M	M	M	
Analog single-channel seismic tracks (map) used in determination of sediment thickness, including shot point numbers and navigation	M	M	M	
FOS points used to derive the 1 per cent sediment thickness points (map)	M	M	M	
Seismic profiles (travel time sections) used to determine sediment thickness (two copies: one original, one interpreted)		M	M	O
Representative seismic profiles (travel time sections) used to determine sediment thickness (two copies: one original, one interpreted) to indicate character of margin	M			
Travel time difference between sea floor and basement (map):				
- If 1 per cent points based on isopachs	O	M	M	
- If 1 per cent points based on profiles	O	M	M	
Sediment thickness (map) showing depth-converted versions of travel time difference maps:				
- If 1 per cent points based on isopachs		M	M	
- If 1 per cent points based on profiles		O	O	
Survey parameters keyed to seismic profiles (table), including the acquisition method, time/depth conversion table/plot and accuracy indicators for location and velocity		M	M	O
Velocity analyses (table) on which time/depth conversion was based		M	M	O
Location of all data used as basis for velocity analyses (map), indicating whether refraction, ocean bottom seismometer, sonobuoy, borehole, wide-angle reflection or other method was used		M	M	O

/...

Type of information to be submitted	Who must have access to this information			
	C	S	St	L
All depth-converted profiles (sections or horizon plots) annotated to show sea floor, basement surface, FOS and 1 per cent point:				
- If 1 per cent points based on profiles		M	M	
- If 1 per cent points based on isopachs		O	O	
Representative depth-converted profiles (sections or horizon plots) annotated to show sea floor, basement surface, FOS and 1 per cent point to indicate the character of the margin	O			

All maps and sections shall specify, where relevant:

- Scale,
- Projection,
- Latitude and longitude,
- Vertical exaggeration,
- Contour interval,
- Units,
- Datum,
- Method of construction (e.g., hand or machine contoured),
- Key to all coded lines.

ANNEX II

List of participants in the meeting of the Group of Experts on preparations for the establishment of the Commission on the Limits of the Continental Shelf

United Nations Headquarters
11-14 September 1995

Comandante Alexandre Tagore Medeiros De ALBUQUERQUE
Diretoria de Hidrografia e Navegação (DHN)
Rio de Janeiro
BRAZIL

Mr. Osvaldo Pedro ASTIZ
Capitán de Navío (RE)
Dirección de Asuntos Limitrofes
Ministerio de Relaciones Exteriores, Comercio Internacional y Culto
Buenos Aires
ARGENTINA

Mr. Lawrence F. AWOSIKA
Nigerian Institute for Oceanography and Marine Research
Lagos
NIGERIA

Mr. Harald BREKKE
Senior Geologist
Norwegian Petroleum Directorate (NPD)
Stavanger
NORWAY

Lt. Cdr. Christopher M. CARLETON, MBE, RN
Territorial Waters Officer
Hydrographic Office
Ministry of Defence
Taunton, Somerset
UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

Dr. Peter J. COOK
Chairman
IOC-UN (DOALOS) OSNLR
Intergovernmental Oceanographic Commission
UNESCO
Paris
FRANCE

Mr. Peter F. CROKER
Geophysicist
Petroleum Affairs Division
Department of Transport, Energy and Communications
Dublin
IRELAND

Mr. Karl GUNNARSSON
Geophysicist
National Energy Authority - Orkustofnun
Reykjavík
ICELAND

Mr. Neil R. GUY
Commodore (Ret.)
Hydrographic Office of South Africa
Cape Town
SOUTH AFRICA

Dr. Kazuchika HAMURO
First Secretary
Permanent Mission of Japan to the Conference on Disarmament, Geneva
Ministry of Foreign Affairs
Tokyo
JAPAN

Dr. Richard T. HAWORTH
Director General
Geophysics, Sedimentary and Marine Geoscience Branch
Geological Survey of Canada
Ottawa
CANADA

Dr. Karl HINZ
Head of the Geological and Geophysical Research Division
Bundesanstalt für Geowissenschaften und Rohstoffe
(Federal Institute for Geosciences and Natural Resources)
Hanover
GERMANY

Dr. Tadahiko KATSURA
Head of the Continental Shelf Survey Office
Ocean Surveys Division
Hydrographic Department
Maritime Safety Agency
Ministry of Transport
Tokyo
JAPAN

Mr. Yuri B. KAZMIN
Counsellor
Russian Committee of Geology and Mineral Resources
Moscow
RUSSIAN FEDERATION

Mr. Adam J. KERR
Director
International Hydrographic Bureau
MONACO

Mr. Iaian C. LAMONT
Head of Nautical Division
Hydrographic Office
Royal New Zealand Navy
Auckland
NEW ZEALAND

Mr. LI Haiqing
Secretariat of the Intergovernmental Oceanographic Commission
UNESCO
Paris
FRANCE

Prof. LIU Guangding
Institute of Geophysics
Chinese Academy of Sciences
Beijing
CHINA

Mr. Daniel RIO
Ingénieur du service hydrographique et océanographique de la Marine
Ministère de la Défense
Brest
FRANCE

Dr. Robert W. SMITH
Division of Marine Law and Policy
Office of Ocean Affairs
Department of State
Washington, D.C.
UNITED STATES OF AMERICA

Mr. Adi SUMARDIMAN
First Vice Admiral (Ret.)
Jakarta
INDONESIA

Mr. Philip A. SYMONDS
Principal Research Scientist
Marine, Petroleum and Sedimentary Resources Division
Australian Geological Survey Organization
Canberra
AUSTRALIA

Mr. George TAFT
Office of the Legal Adviser
Department of State
Washington, D.C.
UNITED STATES OF AMERICA